

REMARKS

This is a full and timely response to the outstanding non-final Office Action mailed June 7, 2004. Upon entry of the amendments in this response, claims 20 - 24 remain pending. In particular, Applicant has amended claims 20 – 24, and has canceled claims 1 – 19 with out waiver, disclaimer or prejudice. Applicant has canceled claims 1 - 19 merely to reduce the number of disputed issues and to facilitate early allowance and issuance of other claims in the present application. Applicant reserves the right to pursue the subject matter of these canceled claims in a continuing application, if Applicant so chooses, and does not intend to dedicate the canceled subject matter to the public. Reconsideration and allowance of the application and presently pending claims are respectfully requested.

In the Drawings

In the attached replacement sheets of drawings, Applicant has added a thickness H of the metal ring component in Fig. 7B to clarify how the thickness continually decreases from each side to a center of said via hole. Also in Fig. 7B, a dash line is added to indicate where a first portion 8e and a second portion 8f are in the metal interconnect component 8b. As shown in Fig. 7B, the first portion 8e of the metal interconnect component 8b is located on a first portion of a smooth top surface of the ILD layer 4 and the second portion 8f of the metal interconnect component 8b on the via hole 6b contacts a top surface of the metal ring component 8c. Symbol H is added to show the thickness of the metal ring component which continually decreases from each side to a center of the via hole 6b. A boundary 8d as shown in Fig. 6 is emphasized to show that it is located between the sides of the via hole 6b. Furthermore, according to the process in the original specification, the boundary 8d is formed by photolithography and etching process.

Applicant respectfully asserts that the changes to the drawings are fully supported by the original disclosure and, as such, it is respectfully asserted that no new matter has been added.

Rejections under 35 U.S.C. 112

The Office Action indicates that Claims 20-24 stand rejected under 35 U.S.C. 112, second paragraph. Specifically, the Office Action alleges that it is unclear as to how the metal ring structure continually decrease in thickness as it approaches the center of the via hole. Applicant respectfully traverses the rejection.

In this regard, Applicant respectfully asserts that the original disclosure fully and accurately describes the aforementioned features. However, as set forth above, Applicants have made minor amendments to the drawings and respectfully assert that the rejection has been rendered moot. Specifically, Fig. 7B has been amended to point out a thickness H of the metal ring component. In Fig. 7B, H has a maximum at the sidewall of the via hole 6b and has a minimum at the center of the via hole 6b. Thus, Applicant respectfully assert that it is clear how the metal ring component 8c continually decreases in thickness from each side to a center of the via hole 6b.

For at least these reasons, Applicant respectfully asserts that Claims 20-24 are sufficiently definite and, therefore, comply with the requirement of 35 U.S.C 112, second paragraph. Applicant respectfully requests that the rejection be withdrawn.

Rejections under 35 U.S.C. §103

The Office Action indicates that Claims 20-24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Nagashima* (US 5,312,773) in view of Harada (US 5,341,026).

Applicant respectfully traverses the rejections for at least the following reasons.

With respect to the pending rejection, the Office Action indicates that *Nagashima* teaches (in Figure 7) a via hole 50, an insulator layer (34 and 38) and a metal segment 36, which anticipate the via hole, the insulator and the metal segment in the previous-version of claim 20. Applicant respectfully asserts, however, that the metal segment 36 in Fig. 7 of *Nagashima* is located **between** insulator layers 34 and 38. Therefore, *Nagashima* does not teach or reasonably suggest a metal interconnect structure comprising a metal interconnect component with a first portion located on a first portion of a smooth top surface of the insulator layer.

In addition, neither *Nagashima* nor *Harada* (either individually or in combination) teach, disclose or reasonably suggest that the second portion of the metal interconnect component has a boundary, between two sides of the via hole, defined by a photo-lithography and etching process. For example, in *Nagashima*, all the boundaries of metal 36 are aligned with and located at the edge of a via hole. In *Harada*, the metal interconnect component 100 has all boundaries outside a via hole 6.

Turning now to claim 20, that claim recites:

20. An interconnect structure on a semiconductor substrate, comprising:
- a via hole in a insulator layer exposing a portion of an underlying lower level metal interconnect structure;
 - a recessed metal plug structure located in a bottom portion of said via hole, with said recessed metal plug structure overlying and contacting the portion of said lower level metal interconnect structure exposed in said via hole; and
 - a metal interconnect structure, comprising:

a metal ring component completely located in a top portion of said via hole, contacting a top surface of said recessed metal plug structure, with said metal ring component continually decreasing in thickness from each side to a center of said via hole; and

a metal interconnect component with a first portion thereof located on a first portion of a smooth top surface of said insulator layer and a second portion thereof, on said via hole, contacting a top surface of said metal ring component; wherein said second portion of said metal interconnect component has a boundary, between two sides of said via hole, defined by a photo-lithography and etching process.

(Emphasis added).

Applicant respectfully asserts that the cited references, either individually, or in combination, are legally deficient for the purpose of rendering obvious claim 10. Specifically, Applicant respectfully asserts that neither or a combination of the references teaches or reasonably suggests at least the features/limitation emphasized above in claim 20. Therefore, Applicant respectfully asserts that claim 20 is in condition for allowance. Since claims 21 - 24 are dependent claims that depend from claim 20 either directly or indirectly, Applicant respectfully asserts that these claims also are in condition for allowance.

Cited Art Made of Record


The cited art made of record has been considered, but is not believed to affect the patentability of the presently pending claims.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicant respectfully submits that all objections and/or rejections have been traversed, rendered moot, and/or accommodated, and that the now pending claims 20 – 24 are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

No fee is believed to be due in connection with this amendment and response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Daniel R. McClure', is written over a horizontal line.

Daniel R. McClure, Reg. No, 38,962

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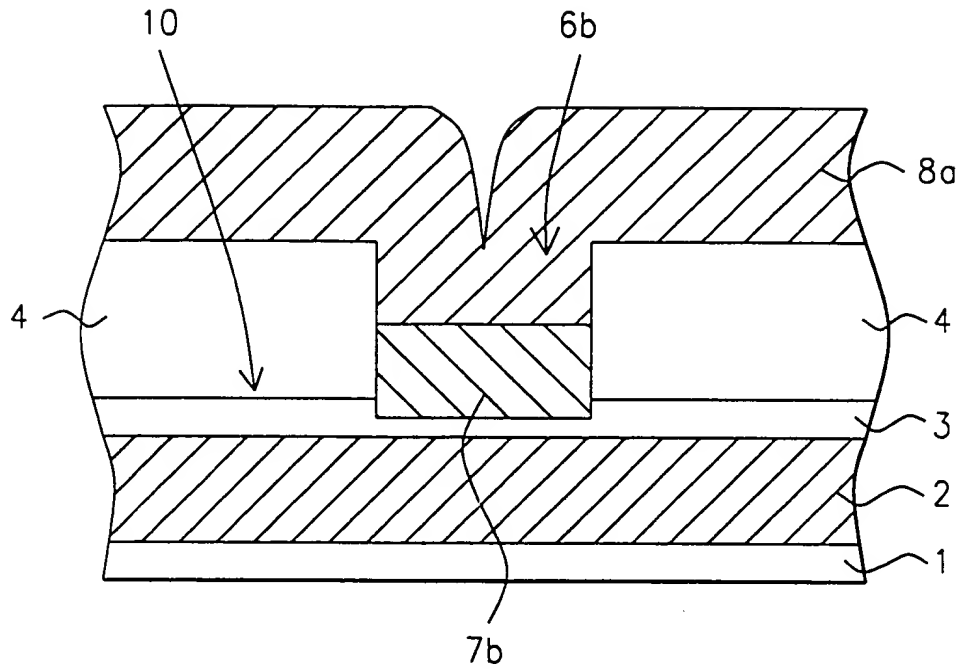


FIG. 5

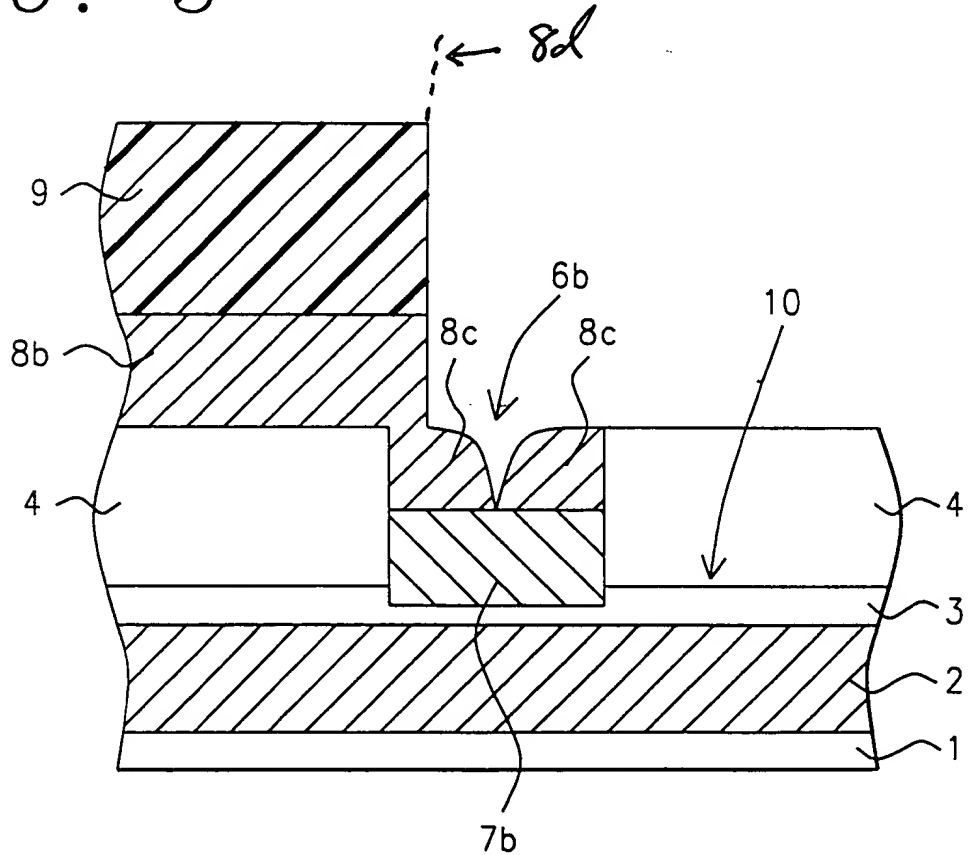


FIG. 6



7A

 $7B$